AMENDMENTS TO THE SPECIFICATION

IN THE SPECIFICATION:

Page 2

Please amend the paragraph beginning at line 15, through line 17, with the following:

A conventional method of generating check matrixes for LDPC codes is explained below. As a check matrix for LDPC codes, the following matrix is proposed in ~~a Non-patent Literature 1~~ "R.G. Gallager, "Low-Density Parity Check Codes", M.I.T Press, Cambridge, MA, 1963" (see Fig. 16).

Page 3

Please amend the paragraphs beginning at line 4, through line 15, with the following:

It is proposed in ~~Non-patent Literature 2~~ Y. Kou, S. Lin, and M. P. C. Fossorier, "Low Density Parity Check Codes Based on Finite Geometries: A Rediscovery", ISIT 2000, pp. 200, Sorrento, Italy, June 25-30, 2000 a method using Euclidean geometry codes as the LDPC codes that exhibit a relatively stable and satisfactory characteristic and can definitely generate a matrix without the use of the computer search. This method explains the "regular-LDPC code" consisting of regular ensembles.

The ~~Non-patent Literature 2~~ second literature proposes a method of generating a check matrix for LDPC codes using Euclidean geometry codes EG (2, 2^6) as a kind of finite geometric codes. This method achieves a characteristic that is located closely but 1.45 decibels away from the Shannon limit at an error rate of 10^{-4}. Fig. 17 is a diagram of a configuration of Euclidean

geometry codes EG (2, 2^2), which has a structure of "Regular-LDPC Codes" with row and column weights of 4 and 4, respectively.

Page 4

Please amend the paragraphs beginning at line 1, through line 22, with the following:

The check matrix generating method in the ~~Non-patent Literature 2~~ second literature further includes changing row and column weights based on the Euclidean geometry codes to extend rows and columns, if necessary. For example, when a column weight in EG (2, 2^2) is separated into halves, in the ~~Non-patent Literature 2~~ second literature, every other one of four weights located in one column is separated into two groups. Fig. 18 is a diagram of an exemplary regular separation of the column weight from 4 into 2.

On the other hand, ~~Non-patent Literature 3~~ M. G. Luby, M. Mitzenmacher, M. A. Shokrollahi, and D. A. Spielman, "Improved Low-Density Parity-Check Codes Using Irregular Graphs and Belief Propagation", Proceedings of 1998 IEEE International Symposium on Information Theory, pp. 171, Cambridge, Mass., August 16-21, 1998 has reported that "irregular-LDPC codes" have a better characteristic than that of "Regular-LDPC Codes". This is theoretically analyzed in ~~Non-patent Literature 4~~ T. J. Richardson and R. Urbanke, "The capacity of low-density parity-check codes under message-passing decoding", IEEE Trans. Inform. Theory, vol.47,No.2, pp.599-618, Feb. 2001 and ~~Non-patent Literature 5~~ S.-Y. Chung, T. J. Richardson, and R. Urbanke, "Analysis of Sum-Product Decoding of Low-Density Parity-Check Codes Using a Gaussian Approximation", IEEE Trans. Inform. Theory, vol.47, No.2, pp.657-670, Feb. 2001. The "irregular-LDPC codes" represent such LDPC codes that have non-

uniformity in either or both of row and column weights.

Particularly, in the ~~Non-patent Literature 5~~ fifth literature, a "Sum-Product Algorithm" for LDPC codes is analyzed on the assumption that a log likelihood ratio (LLR) between an input and an output at an iterative decoder can be approximated in a Gaussian distribution, to derive a satisfactory ensemble of row and column weights.

~~Non-patent literature 1: R.G Gallager, "Low-Density Parity Check Codes", M.I.T Press, Cambridge, MA, 1963.~~

~~Non-patent literature 2: Y. Kou, S. Lin, and M. P. C. Fossorier, "Low-Density Parity Check Codes Based on Finite Geometries: A Rediscovery", ISIT 2000, pp. 200, Sorrento, Italy, June 25-30, 2000~~.

Please delete the paragraphs beginning at line 23, through page 5, line 9 as follows:

~~Non-patent literature 3: M. G Luby, M. Mitzenmacher, M. A. Shokrollahi, and D. A. Spielman, "Improved Low-Density Parity-Check Codes Using Irregular Graphs and Belief Propagation", Proceedings of 1998 IEEE International Symposium on Information Theory, pp. 171, Cambridge, Mass., August 16-21, 1998.~~

~~Non-patent literature 4: T. J. Richardson and R. Urbanke, "The capacity of low-density parity-check codes under message-passing decoding", IEEE Trans. Inform. Theory, vol.47,No.2, pp.599-618, Feb. 2001.~~

~~Non-patent literature 5: S. Y. Chung, T. J. Richardson, and R. Urbanke, "Analysis of Sum-Product Decoding of Low-Density Parity-Check Codes Using a Gaussian Approximation", IEEE Trans. Inform. Theory, vol.47, No.2, pp.657-670, Feb. 2001.~~

Page 5

Please amend the paragraph beginning at line 10, through line 18, with the following:

According to the conventional method of generating check matrixes for LDPC codes disclosed in the ~~Non-patent Literature 5~~ fifth literature, however, the number of "1" points in a row (corresponding to a degree distribution of variable nodes described later) and the number of "1" points in a column (corresponding to a degree distribution of check nodes described later) are both employed as variables to derive the degree distribution of variable nodes and the degree distribution of check nodes that can maximize the following equation (1) (rate: coding rate). In other words, a linear programming is employed to search an ensemble that minimizes a Signal to Noise Ratio (SNR).

Page 10

Please amend the paragraphs beginning at line 10, through line 20, with the following:

The conventional method of generating check matrixes for "irregular-LDPC codes" theoretically analyzed in the ~~Non-patent Literature 5~~ fifth literature is explained next in detail. In this case, a "sum-product algorithm" for LDPC codes is analyzed, on the assumption that a log likelihood ratio (LLR) between an input and an output at an iterative decoder can be approximated in a Gaussian distribution, to derive a satisfactory ensemble of row and column weights.

The method of generating check matrixes for LDPC Codes described in the ~~Non-patent Literature 5~~ fifth literature, or Gaussian Approximation, has a premise that defines a point of "1" on a row as a variable node and a point of "1" on a column as a check node in the check matrix.

Page 12

Please amend the paragraphs beginning at line 4, through line 17, with the following:

LLR message propagation from a variable node to a check node is analyzed next. The following equation (8) is defined on condition that $0<s<\infty$ and $0<r\leq 1$. In this case, r has an initial value r_0 of $\phi(s)$.

$$h_i(s,r)=\phi\left(s+(i-1)\sum_{j=2}^{d_r}\rho_j\phi^{-1}\left(1-(1-r)^{j-1}\right)\right)$$
$$h(s,r)=\sum_{i=2}^{d_l}\lambda_i h_i(s,r) \tag{8}$$

The equation (8) can be represented equivalently by the following equation (9).

$$r_l=h(s,r_{l-1}) \tag{9}$$

A condition required for deriving an SNR limit (threshold) that provides an error with a value of 0 includes $r_l(s)\to 0$. In order to satisfy this condition, it is required to satisfy the following conditional equation (10).

$$r>h(s, r),\ \text{all}\ r\in(0,\phi(s)) \tag{10}$$

In the ~~Non-patent Literature 5~~ fifth literature, optimal degrees are searched for variable nodes and check nodes using the above equation in the following procedure (Gaussian Approximation).

Page 13

Please amend the paragraph beginning at line 11, through line 19, with the following:

A problem is found in the ~~Non-patent Literature 5~~ fifth literature that a check matrix

derived from the maximum of the "rate (coding rate)" is flux, and the rate fixed in design as a specification varies. In addition, in the Non-patent Literature 5 fifth literature, the derivation of the degree distribution associated with variable nodes and the derivation of the degree distribution associated with check nodes are iteratively executes over certain times. Therefore, a problem arises that it takes time to some extent for searching. Further, a problem arises that the check matrix does not easily apply to an optional ensemble, an optional code length, and an optional coding rate.

Page 17

Please amend formula 14 to read as follows:

$$h_i(s,r)=\phi\left(s+(i-1)\sum_{j=2}^{\mu_{max}}\rho j\phi^{-1}\left(1-(1-r)^{j-1}\right)\right)$$

$$h(s,r)=\sum_{i=2}^{\gamma_{max}}\lambda_i h_i(s,r) \qquad (14)$$

$$\phi(x)=\begin{cases}1-\dfrac{1}{\sqrt{4\pi x}}\int_R \tanh\dfrac{\mu}{2}\cdot e^{-}\dfrac{(\mu-x)}{4x}d\mu, & if\ x>0\\ 1, & if\ x\leq 0\end{cases}$$

Page 18

Please amend the paragraph beginning at line 2, through line 8, with the following:

As explained above, according to the present embodiment, the generator functions λ(x) and ρ(x) that satisfy a predetermined condition are obtained at one-time linear programming. Therefore, it is possible to create a definite and characteristic-stabilized ensemble more easily in a shorter time than it is by the method described in the ~~Non-patent Literature 5~~ fifth literature

that iteratively executes derivation of the generator functions $\lambda(x)$ and $\rho(x)$ to derive both optimal values.

Page 19

Please amend the paragraph beginning at line 9, through page 20, line 6, with the following:

Finally, a dividing procedure of one row or one column in the basic matrix after the permutation (step S8) will be explained. The ~~Non-patent Literature 2~~ second literature proposes a regular dividing method concerning the dividing procedure. Fig. 12 is a diagram of the dividing procedure in the literature. First, a matrix is numbered as shown in Fig. 12. In this example, column numbers are given as 1, 2, 3, and so on in order from the left end, and row numbers are given as 1, 2, 3, and so on in order from the top. For dividing 32 points×one column into 8 points×4 columns, for example, this is regularly divided according to the following equation (20).

Page 24

Please amend the paragraphs beginning at line 6, through line 19, with the following:

Characteristics of the above LDPC codes will be compared below. Fig. 15 is a diagram of a relation between an Eb/No (a signal power to noise power ratio per one information bit) and a bit error rate (BER). A decoding method is "Sum-Product algorithm". This characteristic uses the ensemble shown in Fig. 11. Fig. 15 is a characteristic comparison between the execution of the regular division as described in the ~~Non-patent Literature 2~~ second literature and the

execution of the division according to a Latin square of random sequences.

As is clear from Fig. 15, according to the regular division as described in the ~~Non-patent Literature 2~~ second literature, a large improvement cannot be expected even with "irregular-LDPC codes". In contrast, the random division of the present embodiment can provide a remarkably improved performance when it is implemented because the probability of the occurrence of a loop decreases substantially.